

The Federation of Earth System Information Partners (ESIP) Education Committee strives to make remotely sensed data accessible and meaningful to educators. Over the years, ESIP Education has pursued numerous science literacy initiatives, including an annual workshop co-located at ESIP summer meetings which rotates around the country, providing the perfect opportunity to reach a new group of regional educators each year. And since many ESIP members develop educational resources, there is a clear benefit to fostering a synergistic environment between ESIP members and educators. To date, over 200 teachers from numerous states have participated in ESIP Education Workshops. Evaluations garner high ratings and helpful suggestions to improve successive endeavors, including the 2016 ESIP Education initiative involving the use of recreational Unmanned Aircraft Systems (UAS, or drones) for STEM activities and science fair projects. Along with photos from past ESIP workshops, this poster summarizes the exciting July 2016 ESIP Education Workshop facilitating STEAM (Science, Technology, Engineering, Art and Math) using recreational drones in clubs, classrooms, and science fairs.



2009 ESIP Teacher Workshop  
UCSB Bren School of Environmental Science



2010 ESIP Teacher Workshop  
University of Tennessee Knoxville



2011 ESIP Teacher Workshop  
Santa Fe New Mexico



2012 ESIP Teacher Workshop  
CIMSS - University of Wisconsin-Madison



2013 ESIP Teacher Workshop  
UNC - Chapel Hill



2015 ESIP Teacher Workshop  
Asilomar, Pacific Grove California



## 2016 Initiative facilitating STEAM (Science, Technology, Engineering, Art & Math) with recreational drones

### Two Webinars and a Workshop

Webinar 1: March 22 4 EDT	Webinar 2: April 26 4 EDT	Workshop: July 19, Durham, NC
<b>UAVs 4 STEM</b> Learn about real-world uses of drone technology for science and humanitarian efforts. Find out how you and your students can use recreational drones for STEM learning.	<b>Plan, Fly, Review: Documenting Drone Data</b> Get organized so you can learn something from every UAV flight. Learn best practices for documenting your flights, images, and science data.	<b>Test and Refine STEM Learning Activities</b> Fifteen successful applicants will receive a drone and a \$200 stipend to test and refine activity ideas, and then use them with youth in the fall. The workshop will prepare attendees to facilitate drone-based STEM learning in clubs, classrooms, or science fair activities.

#### OUTCOMES

- 1) Downloadable e-book of STEM activities for recreational drones
- 2) Cadre of educators ready to facilitate activities & data management strategies
- 3) Opportunity for follow-on data explorations
- 4) Advancing STEM literacy and engagement
- 5) Strengthening the pipeline to STEM careers



Sample Activity Idea: [Drone-only experiment, testing physical properties]

### What payload can my UAV carry?

Materials: Set of washers or bolts  
String  
Balance, or a food or postal scale

Small sensors that measure environmental conditions such as temperature, air pressure, and location are becoming widely available. Can your drone carry these into flight?

Design and conduct an experiment to find a practical limit on the payload mass your UAV can carry. Consider the Sample Data Table at right: expand as necessary to capture data from multiple trials. Use graphics, videos, or photographs to document your results.

Sample Data Table

	UAV only	UAV + Payload #1	UAV + Payload #2
Mass			
Ability to launch (good, fair, poor, fail)			
Ability to maneuver (good, fair, poor, fail)			
Payload mass			

Sample Activity Idea: (Taking photos / videos)

### How can drone images enhance GLOBE's land cover classification protocol?

Materials: UAV with camera  
[GLOBE's Climate and Land Cover Project](#)

Could using images from a drone help you classify more land, or do so with greater accuracy, than the current GLOBE protocol?

1. Select a study site and gather field measurements as directed by GLOBE's Climate and Land Cover Project.
2. Modify the protocol for use with a drone, and then gather similar measurements.
3. Compare your efforts and results

Sample Comparison Chart

	GLOBE protocol	Modified Protocol
Enacted procedures		
Land area classified		
Time and Resources required		
Advantages		
Disadvantages		

Sample Activity Idea (Taking photos / videos)

### How are UAV photos the same or different from satellite images?

Materials: 1) Satellite image of your location (acquired via SatCam app, Google Earth or any free resource)  
2) UAV with a camera

Take a close look at a satellite image of a place where you can fly your UAV. What can you see? What can't you see?

Use your UAV to take images of the area you examined: compare and contrast what you see in the two images. Prepare a graphic showing the satellite view and a UAV view of the same place, and document the qualitative and quantitative differences between them. Use a chart, a Venn diagram, and/or a graph to explain differences and similarities in the two kinds of images.

Sample Comparison Chart

	Satellite Image	UAV photo
Source (drone camera or satellite instrument)		
Area covered (include units)		
Smallest feature (spatial resolution)		
Practical temporal resolution		
Examples of effective uses for each platform - what can you study?		